

NORTHEAST OHIO REGIONAL SEWER DISTRICT

2011 Doan Brook Environmental Monitoring



**Prepared by
Water Quality and Industrial Surveillance Division**

Introduction

In 2011, the Northeast Ohio Regional Sewer District (NEORS) conducted water quality sampling, habitat assessments, and fish and benthic macroinvertebrate sampling on Doan Brook at the Lakeshore Boulevard site at River Mile 0.75. The data was evaluated to determine the extent to which the downstream communities may be impacted by CSOs or other environmental impairments. RM 0.75 was also evaluated to see if there were any impacts from point and non-point sources of pollution. Sampling was conducted by NEORS Level 3 Qualified Data Collectors certified by Ohio Environmental Protection Agency (EPA) in Fish Community and Benthic Macroinvertebrate Biology, and Chemical Water Quality and Stream Habitat Assessments as explained in the NEORS study plan *2011 Doan Brook Environmental Monitoring* approved by Ohio EPA on June 18, 2011.

Macroinvertebrate sampling at RM 0.75 is required by Ohio EPA Permit No. 3PA00002*FD. Although not required, fish and habitat assessments were also conducted at this location.

Doan Brook is about 8.5 miles in length, originating east of Warrensville Road in Shaker Heights. The two branches flow through upper Horseshoe lakes in Shaker Heights, before joining the marsh at the Nature Center in Shaker Heights. The brook then flows through Lower Lake down to west of Coventry Road into a mile-long culvert at Ambler Park in the City of Cleveland. Doan Brook then flows past the Cleveland Museum of Art, through Rockefeller Park along Martin Luther King Boulevard, and under the Dike 14 Nature Preserve (formally a confined material disposal site) before finally entering Lake Erie.

Figure 1 is a map of the sampling location evaluated during the study, and Table 1 indicates the sampling location with respect to river mile (RM), latitude/longitude, description, and the types of surveys conducted.



Figure 1. Sampling Location

Table 1. Sampling Location						
Site Location	Latitude	Longitude	River Mile	Description	Quadrangle	Purpose
Doan Brook	N41.5330°	W81.6296°	0.75	Downstream of St. Clair Avenue	Cleveland North	Evaluate chemistry, habitat, fish, & macroinvertebrates in support of Ohio EPA Permit #3PA00002*FD

Water Chemistry and Bacteriological Sampling

In 2011, water quality samples, consisting of chemistry and bacteriological sampling, were collected from Doan Brook at the location listed in the above table. Six samples were collected from June 28, 2011 to August 3, 2011. All of the water chemistry sampling followed the *Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices* (2009a). Water quality monitoring of Doan Brook prior to the completion of capital improvement construction projects, such as the Doan Valley Storage Tunnel, will provide baseline data which, after work completion, will demonstrate any improvements in water chemistry and the aquatic life community present in the brook.

For each water quality sampling event, a sample was collected in two 4-liter disposable polyethylene Cubitainers with disposable polypropylene lids, two 473-milliliter (mL) plastic bottles, and one 250-mL treated bacteriological bottle. One plastic bottle was field preserved with trace nitric and the other with trace sulfuric acid. All samples were placed in a cooler with ice and stored on the locked vehicle until the samples were transferred to NEORSD's Analytical Services sample receiving area. All samples were released to an authorized Analytical Services employee with a Chain of Custody.

Field parameters were measured in stream. Field analyses included the use of a YSI-556 MPS Multi-Parameter Water Quality Meter or a YSI 600 XL sonde to measure dissolved oxygen, water temperature, conductivity and pH at the time of sampling. A Surface Water Condition Sampling Field Data Form was filled out for each site during each sampling event.

On August 3, 2011, one sample duplicate and one field blank was collected for QA/QC purposes. The results from the sample duplicate was compared to the primary sample using relative percent difference (RPD), see Formula 1:

Formula 1)

$$\text{RPD} = \left(\frac{|X-Y|}{((X+Y)/2)} \right) * 100$$

X= is the concentration of an analyte in the primary sample

Y= is the concentration of the same analyte in the duplicate sample

An RPD was calculated for each of the 45 individual chemical parameters reported on the Certificates of Analysis. The sample and the sample duplicate were compared, and after each RPD was calculated, any differences over 40% were investigated. Forty per cent is allowable for field samples; those that are higher may indicate problems with sample collection and as a result the data may be considered estimated or, because it does not fulfill the requirements of level 3 credible data, downgraded to level 2 and used to determine trends only. An RPD greater than 60% results in rejection of the data. From the blank and duplicate samples that were collected during this study, there were no instances when the results were above the practical quantitation limit in which the RPD between the two samples was greater than 40%.

Results and Discussion

Doan Brook is designated Warmwater Habitat (WWH), agricultural water supply, industrial water supply, and primary contact recreation. The Lake Erie Drainage Basin (LEDB) human health non-drinking water criteria and the wildlife criteria also apply to each site. The Class B Primary Contact Recreational Use Criteria apply for *Escherichia coli* (*E. coli*). The water chemistry samples collected at each site were compared to the applicable Ohio Water Quality Standards for the designated uses to determine attainment (Ohio EPA, 2009a).

Mercury analysis for all of the samples was completed using EPA Method 245.1. Because the detection limit for this method is above the criteria for the Human Health Nondrinking water and Protection of Wildlife Outside Mixing Zone Averages (OMZA), it generally cannot be determined if Doan Brook was in attainment of those criteria. Instead, this type of mercury sampling was used as a screening tool to determine contamination above those levels typically found in the creek. For the data that was collected in 2011 (Table 2), the site at RM 0.75 had mercury concentrations that resulted in 30-day averages that exceeded the Human Health Nondrinking water and Protection of Wildlife Outside Mixing Zone Averages (OMZA). It is expected that the use of EPA

Method 1631E for all of the samples would have resulted in exceedances throughout the sampling.

Sample Date	Method	MDL (µg/L)	PQL (µg/L)	Concentration ¹ TR (µg/L)	Adjusted Concentration ² TR (µg/L)	30-day period	Average Concentration	OMZA Criterion (Wildlife)	OMZA Criterion (Nondrinking)
6/28/2011	EPA 245.1	0.005	0.050	<0.005	0.0025	6/28/11-7/28/11	0.007	0.0013	0.0031
7/06/2011	EPA 245.1	0.005	0.050	<0.005	0.0025	7/06/10-8/05/11	0.007	0.0013	0.0031
7/13/2011	EPA 245.1	0.005	0.050	<0.005	0.0025	7/13/10-8/12/11	0.008	0.0013	0.0031
7/20/2011	EPA 245.1	0.005	0.050	0.013	0.013	7/20/10-8/19/11	0.003	0.0013	0.0031
7/27/2011	EPA 245.1	0.005	0.050	<0.005	0.0025	7/27/10-8/26/11	0.003	0.0013	0.0031
8/03/2011	EPA 245.1	0.005	0.050	<0.005	0.0025	--	--	--	--
¹ TR= Total Recoverable		² For concentrations below the detection limit, ½ the detection limit used for comparisons.				Shaded area= 30-day-period exceedance			

Doan Brook at RM 0.75 was in non-attainment of the *E. coli* criteria for Class B primary contact recreation use by exceeding the sample criterion of 523 colony-forming units per 100 milliliters (CFU/100 ml) in more than ten percent of the samples taken in a 30-day period for five thirty-day periods between June 28, 2011 and August 26, 2011. The seasonal geometric mean at RM 0.75 was 987.5 CFU/100mL and, therefore, the site was also in non-attainment of the seasonal geometric mean criterion of 161 CFU/100 mL. Table 3 lists the *E. coli* results for each sample.

Sample Date	St. Clair Ave. RM 0.75 <i>E. coli</i> CFU/100mL	Precipitation ¹ Within 3 days of sampling, Rain Gauge at Wade Park Total inches
6/28/2011	520	0.52
7/06/2011	360	0.00
7/13/2011	340	0.30
7/20/2011	2000	0.04
7/27/2011	620	0.00
8/03/2011	11750	0.00

Wet Weather Event

The NEORSD 2010 Community Discharge Program Status Report has documented a number of Sanitary Sewer Overflows (SSOs) and Combined Sewer Overflows (CSOs) flowing to Doan Brook. There are forty-two SSOs (Table 4) in Cleveland Heights and Shaker Heights that fall within the Doan Brook watershed. Other documented dry weather overflows to the north and south branches of Doan Brook in 2011 are listed in Table 5. Any overflows from these sources have the potential to cause elevated bacteria levels in Doan Brook.

Table 4.
Sanitary Sewer Overflows (SSOs) on Doan Brook

Community	SSO #	Location
Cleveland Heights	C-17	Monmouth East of Dartmoor
Cleveland Heights	CH-1, CH-2	Fairmount at North Woodland.
Cleveland Heights	CH-32	Fairmount at Arlington.
Cleveland Heights	CH-38	Fairmount at Marlboro.
Cleveland Heights	CH-35	2393 Coventry, west of Fairmount.
Cleveland Heights	CH-33	Fairmount at Fairfax.
Cleveland Heights	CH-36	North Park and Coventry.
Cleveland Heights	CH-37	Fairfax at North Park Blvd..
Cleveland Heights	CH-42	12537 Cedar Road
Cleveland Heights	CH-09	Bradford and Lee Road
Cleveland Heights	CH-05,CH-06, CH-07	Fairmount at South Fairmount
Cleveland Heights	CH-03	Fairmount at Wellington
Cleveland Heights	CH-13	Hampshire Lane at Euclid Hts. Blvd.
Cleveland Heights	CH-39	3012 North Woodland
Cleveland Heights	CH-04	Fairmount at Dartmoor
Cleveland Heights	CH-08	Fairmount at Lee Road
Cleveland Heights	CH-45	2764 Fairmount
Cleveland Heights	CH-46	Edgehill at Euclid Hts. Blvd.
Cleveland Heights	CH-15	Coventry at Cedar Road
Cleveland Heights	CH-24	3003 Euclid Hts. Blvd.
Cleveland Heights	CH-49	2765 Fairmount east of Church Ave.
Cleveland Heights	CH-47	2528 Stratford north of Monmouth
Cleveland Heights	CH-23	2828 Berkshire east of Coventry
Cleveland Heights	CH-IX	Cedar Road at Bellfield
Cleveland Heights	CH-19	Oakhill at North Vale
Cleveland Heights	CH-2X	Cedar Road and Grandview
Cleveland Heights	DV-15	2330 Euclid Hts. Blvd.
Cleveland Heights	DV-16	Cedar at South overlook
Cleveland Heights	DV-32	Fairmount at Fairfax

Community	SSO #	Location
Cleveland Heights	DV-28	12537 Cedar Rd.
Cleveland Heights	63	Coventry Rd. South of Fairmount
Shaker Heights	HL01,HL02	South Park Blvd. at Attleboro
Shaker Heights	VA-09	Ingleside and Fernway
Shaker Heights	S1X1,S1X2	Shaker at Lee Road
Shaker Heights	S1HX	South Park Blvd. at Lee Road
Shaker Heights	DV-45	South Woodland at West Park
Shaker Heights	VIBX	Southington at Huntington

Date found	Location	Overflow (gal./event)
8/17/2011	DV-01, Stokes Blvd. at Baldwin Road	180,956
11/04/2011	E-44, East 93 rd and Ansel Road	41,469

Habitat Assessment

Methods

The Qualitative Habitat Evaluation Index (QHEI) score was determined on Doan Brook on the main branch at RM 0.75. The QHEI, developed by Ohio EPA, is used to assess the aquatic habitat conditions at each sample location by providing an evaluation of the physical components of a stream. The index is based on six metrics: stream substrate, instream cover, stream channel morphology, riparian and bank condition, pool and riffle quality, and stream gradient. These metrics describe the physical attributes of a stream and may be important in explaining why fish species are present or absent. A more detailed description of the QHEI can be found in Ohio EPA's (2006), *Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI)*. The Ohio Environmental Protection agency has set a QHEI target goal of 60 for WWH, with a score of ≥ 60 indicating adequate habitat diversity to support a warmwater community of fish. The QHEI field sheet for is available upon request from WQIS.

Results and Discussion

A QHEI of 60 (*Good*) was calculated for the site. Gravel and sand were the predominant substrate types with sparse instream cover consisting of shallows, deep pools, boulders, and woody debris. There was little to no bank erosion and the surrounding area is residential/park. The habitat at this site has been consistent the past three years, meeting or exceeding the QHEI target goal of 60 for WWH. This indicates adequate habitat diversity to support a warmwater community of fish. (Table 6).

River Mile	2009	Narrative Rating	2010	Narrative Rating	2011	Narrative Rating
0.75	62.0	Good	62.5	Good	60	Good

Electrofishing

Methods

In 2011, electrofishing was conducted two times at RM 0.75, which is a headwater site (drainage area <20 square miles), in accordance with the Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volume III: Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities* (1987b).

Longline electrofishing techniques were used to shock all habitat types within the sampling zone. The zone was 0.15 kilometers in length, and shocking consisted of moving from downstream to upstream. Fish were identified to species level and counted and examined for the presence of external anomalies including deformities, erosions, lesions, and tumors (DELTs). A list of these results is available upon request from WQIS.

Results from electrofishing sampling were used to calculate the Index of Biotic Integrity (IBI). The IBI is used to assess fish community health at a site. Twelve metrics comprise the IBI for headwater sites:

1. Number of Native Species
2. Number of Darter Species
3. Number of Headwater Species

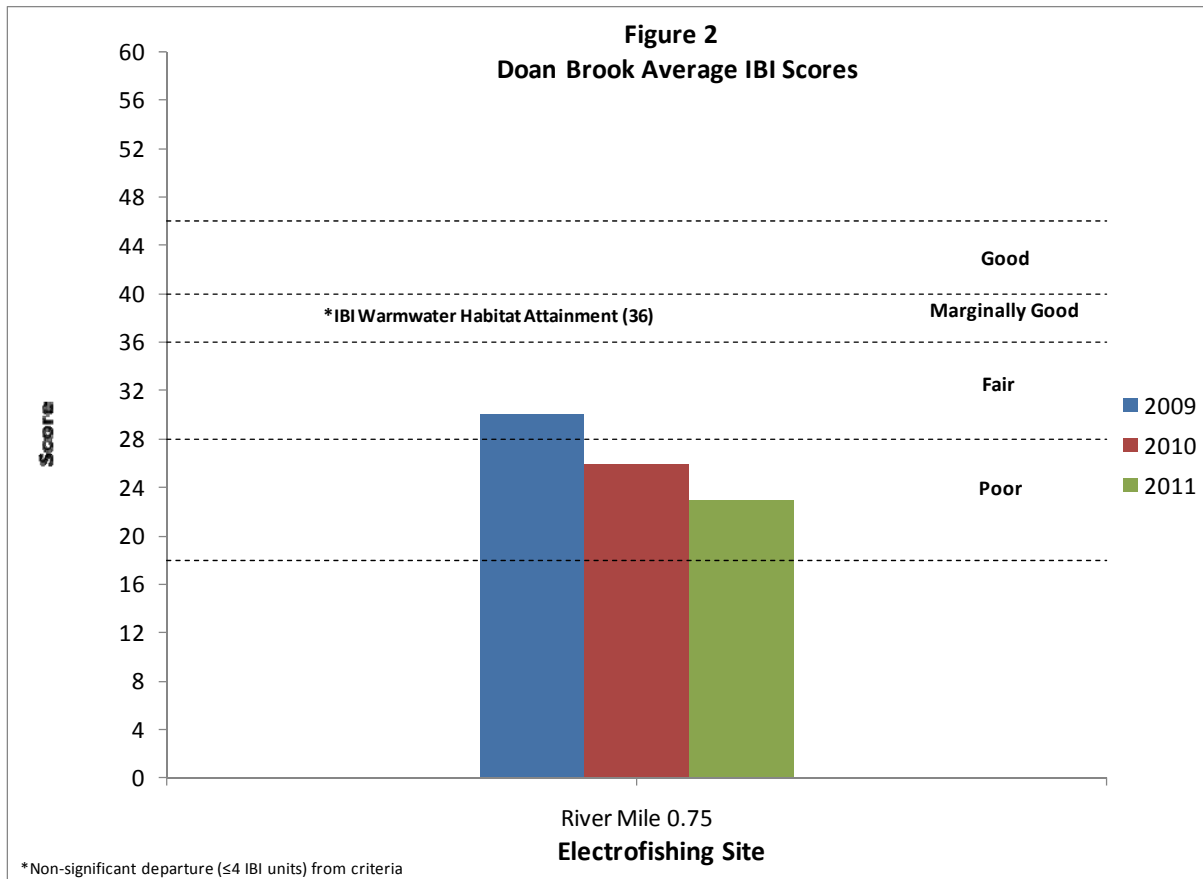
4. Number of Minnow Species
5. Number of Sensitive Species
6. Proportion of Tolerant Species
7. Proportion of Omnivores
8. Proportion of Insectivores
9. Proportion of Pioneering Species
10. Number of Individuals
11. Number of Simple Lithophilic Species
12. Proportion that are Deformed, have Eroded Fins, Lesions or Tumors (DELTs)

The summation of the twelve individual metric scores provides a single-value IBI score, which corresponds to a narrative rating of *Exceptional*, *Good*, *Marginally Good*, *Fair*, *Poor* or *Very Poor*. The maximum possible IBI score is 60 and the minimum possible score is 12. An IBI score of ≥ 36 at headwater sites indicates attainment of the WWH biocriterion in the Erie Ontario Lake Plain ecoregion.

Results and Discussion

In 2011, RM 0.75 obtained an average IBI score in the *Poor* range (23), failing to meet the WWH IBI criterion of 36 (Table 7 and Figure 2). Of the fish collected, 63% were highly pollution tolerant, consisting of common white suckers, brown and yellow bullheads, green sunfish, creek chubs and goldfish. The bluegill sunfish and pumpkinseed sunfish were the only moderately pollution-tolerant fish collected. The score decreased slightly from a score of 26 (*Poor*) in 2010 to a score of 23 in 2011. The decreased score was likely due to a lower score in the proportion of DELT anomalies metric, correlating to a high incidence of multiple lesions on the goldfish and eroded barbels and lesions on the brown and yellow bullheads. Twenty-four or 15% of the fish collected on June 15, and August 1, 2011, had DELT anomalies present. 2009 IBI scores were within the *Fair* range (30). The 2011 QHEI score of 60 (*Good*) shows the habitat being able to support WWH species; however, poor water quality may be one reason why a better diversity of fish was not present, and the fish that were present were not as healthy.

River Mile	2009	Narrative Rating	2010	Narrative Rating	2011	Narrative Rating
0.75	30	Fair	26	Poor	23	Poor



Macroinvertebrate Sampling

Methods

Macroinvertebrates were sampled quantitatively for one six-week period in 2011 using a modified Hester-Dendy artificial substrate sampler (HD), in conjunction with a qualitative assessment performed during retrieval. The modified HD is a type of sampling that has been utilized by the Ohio EPA since 1973 (DeShon, 1995).

The Invertebrate Community Index (ICI) was used as the principal measure of overall macroinvertebrate community condition. Developed by the Ohio EPA, the ICI is a modification of the Index of Biotic Integrity for fish (OEPA, 1987a). The ICI consists of ten individually scored structural community metrics:

1. Total number of taxa
2. Total number of mayfly taxa

3. Total number of caddisfly taxa
4. Total number of dipteran taxa
5. Percent mayflies
6. Percent caddisflies
7. Percent Tanytarsini midges
8. Percent other dipterans and non-insects
9. Percent tolerant organisms
10. Total number of qualitative Ephemeroptera, Plecoptera, and Tricoptera (EPT) taxa

Macroinvertebrate qualitative samples were sent to Midwest Biodiversity Institute (Columbus, Ohio) for identification and enumeration. Specimens were identified to the lowest practical taxonomic level as recommended in Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volume III* (1987, updated September 30, 1989; November 8, 2006; and August 26, 2008). The taxa lists and enumerations are available upon request.

Results and Discussion

Doan Brook RM 0.75 received an ICI score of 24 with a narrative rating of *Fair* (Table 8). The highest scoring metrics (scores of 6) were for number of caddisfly taxa (3 taxa) and percent caddisflies composition (4.8%). Predominant caddisfly taxa consisted of *Cheumatopsyche* species and the net-spinning filter-feeding caddisflies of the family Hydropsychidae. Micro-caddisflies of the family Hydroptilidae, taxa *Hydroptila* species, and the one additional Hydropsychidae family species, taxa *Hydropsyche depravata* group, were also collected. The percent caddisfly composition also scored high because of the high number of *Cheumatopsyche* species collected. Better scores were obtained in 2010 because of a higher percentage of Tanytarsini midges present then as compared to 2011. In 2010, Tanytarsini midges comprised 40.9% (809 organisms) of the community composition with a metric score of 6, compared to Tanytarsini midge composition of 6.9% (142 organisms) in 2011 and score of 2. In 2011, the pollution tolerant *Polypedilum (P.) illinoense* species and Oligochaeta taxa accounted for the most dominant groups collected at RM 0.75. When the HD was retrieved, it was found approximately 10 meters downstream of the original location. Possibly, the movement of the HD may have disrupted some of the macroinvertebrates that were colonized on it and, therefore, could account for some of the changes in composition between 2010 and 2011. A greater amount of rainfall during the colonization period in 2011 may have also had a negative impact on the macroinvertebrate community.

Table 8.						
2009-2011 Averaged Invertebrate Community Index Scores						
River Mile	2009	Narrative Rating	2010	Narrative Rating	2011	Narrative Rating
0.75	28	<i>Fair</i>	32	<i>Good</i>	24	<i>Fair</i>

Conclusions

Bacteriological sampling showed elevated *E. coli* densities at RM 0.75, an indication of generally poor water quality conditions in Doan Brook. As a result, a relatively high percentage of pollution-tolerant fish and macroinvertebrate species were present in the stream. The more sensitive species may be avoiding the area because of the contaminants present. Flows originating from sanitary sewer overflows and CSOs may be contributing to the elevated levels of *E. coli* and, potentially, other pollutants.

The macroinvertebrate community in Doan Brook received a *Fair* rating in 2011. Thirty-four macroinvertebrate taxa were collected in 2011 compared to thirty-six taxa collected in 2010. The lower ICI score in 2011 compared to 2010 may be attributed to the disturbance of the HD when it was removed or possibly because of more significant wet weather events. The HD was discovered about 10-yards downstream from the original installation area. While the HD drifted downstream, some of the organisms might have become detached and lost in the current. This resulted in fewer organisms on the HD when removed. Organisms may also have become detached during high flows in the stream.

The fish community also appeared to be impacted from the water quality conditions. From 2009 thru 2011, four longline electrofishing passes were completed at the Doan Brook site (RM 0.75). Of the four passes completed, three rated *Poor* for the IBI fish community scores. A *Fair* value was obtained once, in 2009. Six out of the eight species of fish collected at RM 0.75 were highly pollution-tolerant fish. Because the habitat in Doan Brook met Ohio EPA's target for warmwater habitat, it is not expected that the fish community will be in attainment of the warmwater habitat criterion until water quality improves in the stream.

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Analytical Services Division – Completed analysis for all water chemistry sampling

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